Title: Incidence, prevalence and consequences of illness in Academy rugby league players

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Abstract

Objectives: To assess the incidence, prevalence and consequences of illness in one professional academy rugby league club during an in-season period.

Design: Observational prospective cohort study.

Method: Seventeen male rugby league players (age 17.7 ± 0.7 years, stature 178.8 ± 5.1 cm, body mass 87.2 ± 9.6 kg) completed a weekly self-report illness questionnaire using an amended version of the Oslo Sports Trauma Research Centre (OSTRC) questionnaire on health problems.

Results: A total of 24 new illnesses were reported over the 25-week study period. 65% of players experienced at least one illness during the study. The incidence of illness in this cohort was 14.3 per 1000-player days, with the respiratory system being most commonly affected (*n = 15; 62.5%*). The average weekly illness prevalence was 10.3%. Time-loss illness incidence was 1.4 per 1000-player days. Loss of body mass and sleep disruptions were the most commonly reported consequences of illness episodes. Mean body mass loss during a period of illness was 2.2 ± 0.6 kg.

Conclusions: Academy rugby league players are most commonly affected by respiratory illness with a total of nineteen training and competition days lost to illness. Associated consequences of illness, such as loss of body mass and sleep disruptions may present a challenge and negatively impact a rugby league player's development. Appropriate medical provisions should be provided for Academy rugby league players to provide support during periods of illness to limit the impact of these consequences.

Key words: epidemiology; team-sport athletes; acute illness; self report; adolescent

Introduction

Illness in athletes can be detrimental to health and performance, resulting in a possible reduction in/of performance and time-loss from training and competition [1]. Increased training loads, regular travel, poor nutrition, reduced sleep and lack of appropriate hygiene practices may all contribute to increased risk of illness [1, 2]. Due to their close-proximity to team mates and other athletes, team-sport athletes may experience an increased risk of illness [3, 4]. In particular, rugby players may experience an increased susceptibility to illness and infection due to the unique contact demands experienced training and during match-play, including the strenuous physical nature and frequent skin to skin contact [4-6].

Much of the illness monitoring research within rugby focuses on rugby union, with studies dating back as early as 1979, assessing scrum-pox and methicillin resistant Staphylococcus aureus (MRSA) [7, 8]. More recent research has assessed illness in rugby union during both training and competition periods [9-11], identifying that players experience an incidence of 20.7 illnesses per 1000-player days [9] with 92% of all players suffering from at least one upper respiratory illness (URI) over a season [11]. Illness monitoring in rugby league has received little attention, with only a limited number of studies published to date [2, 12, 13].

Rugby league provides a unique population due to the high-intensity bouts and frequent collisions [14], as well as the sport's winter pre-season and summer in-season (when played in the Northern Hemisphere) potentially exposing players to a variety of temperature and environmental extremes. Previous illness monitoring research in rugby league has identified an average incidence of 1.4 illnesses per player per season [12], however research has predominantly focused on full-time professional players and is yet to be undertaken within Academy cohorts. Academy (i.e., Under 19s age group) rugby league players are typically part-time adolescent players who are challenged with balancing compulsory education, professional rugby, adolescent growth and high-training loads to drive adaptation and physical development [15]. Additionally, many Academy rugby league players struggle to meet basic

dietary requirements for these physiological demands [16], therefore, players may experience an elevated risk of illness. Due to the importance of physical development for these players [17, 18], illness may be of increased concern due to potential consequences such as; physical implications (i.e., lack of sleep and loss of body mass), availability for squad selection and time-loss from training [11, 19]. Previous research has identified that athletes who sustain two or more illnesses in a season are three times less likely to achieve their goals than those who sustained fewer [20].

To the authors' knowledge, no studies to date have assessed illness incidence or prevalence in Academy rugby league players. Furthermore, the consequences of illness in this population remain unknown. Therefore, the aim of this study was to assess the incidence, prevalence and consequences of illness in one professional academy rugby league club during an in-season period.

Methods

An observational prospective cohort study was conducted to investigate the incidence, prevalence and consequences of illness in Academy (i.e., Under 19s) rugby league players during the 2018/19 in-season period (April to September 2019).

Seventeen male rugby league players (age 17.7 ± 0.7 years, stature 178.8 ± 5.1 cm, body mass 87.2 ± 9.6 kg) participated in the study. Participants were recruited from one English Super League Academy squad. All participants were made aware of the benefits and perceived risks of the study and provided written informed consent. Ethics approval was granted by Leeds Beckett University Ethics Committee (*no. 57455*).

Participants completed a weekly self-report illness questionnaire using an amended version of the Oslo Sports Trauma Research Centre (OSTRC) questionnaire on health problems [21]. The OSTRC questionnaire on health problems is adaptable to a wide variety of sports and monitors

self-reported outcome measures of the symptoms, severity and impact of illness [22]. Validated in elite athlete cohorts and developed from the validated OSTRC overuse injury questionnaire [23], the questionnaire has the potential to form a model that could be used for athlete monitoring across a wide variety of sports [22].

An adapted version of the International Olympic Committee's (IOC) definition of illness was used for this study: "*a new or recurring symptomatic illness that was incurred during competition or training, which either received medical attention or was self-reported by the player, regardless of the consequences with respect to absence from competition or training*" [1]. For the purpose of this study, subclinical immunological precursors of symptomatic illness were not measured.

Participants completed the questionnaire at afternoon training (4pm), on the same day (Thursday), once a week, using an online Google document (Google Forms, Google, CA, USA), alongside their pre-existing wellness monitoring. Participants were asked to report information about illnesses they had been experiencing over the past week, including reoccurring illnesses (illnesses affecting the same body system which were reported across two reporting periods) and were able to report up to five different illnesses each week.

The amended version of the OSTRC questionnaire consisted of four key questions (Figure 1) and six additional questions; injury was removed for the purpose of this study. The questionnaire asked participants about the impact of illness on their sport participation, training volume, performance and severity of symptoms experienced during the previous seven days [21, 24]. If the participant reported that there had been no impact on any of the four key questions (i.e. full participation without illness / no training / performance reduction / no symptoms), the questionnaire was finished for that week [21]. If, however, participants answered anything other than "no illness / impact" on any of the four key questions, they were directed to answer additional questions. Participants could report multiple symptoms for the same illness and any

time lost in days; this was defined as a loss of one or more training or match days [9]. Time-loss was confirmed by the lead researcher for accuracy in the participants' reporting. A full copy of the questionnaire can be found in online supplementary material one.

<Insert Figure 1 near here>

For the purpose of this study, an open-ended question was added to identify any additional consequences of the reported illness. Fasted body mass was collected twice a week as part of the participants' standard practice. Players followed the same protocol, including using the same scale, being in a fasted state post urine void, first thing in the morning for every weigh in. Education was provided to players to ensure they measured their body mass in the correct way. When a player reported as ill, the change in body mass during this period was reported. Participants with illnesses of major concern or those which presented for more than 4-6 weeks were referred to the club doctor by the sports science department (i.e., physiotherapist/sports scientist/nutritionist). As outlined in previous literature, similar illnesses reported in close proximity to each other were treated as a single case for incidence analysis purposes [23, 24].

Illnesses were coded by symptoms and body system affected [21] using the International Classification of Primary Care, V.2 (ICPC-2) by the lead researcher and a medically trained physician.

Data from the first week of collection were excluded from all calculations due to potential over-reporting, as previously recommended [23]. Descriptive data are presented as mean ± SD. Prevalence was defined as the proportion of the study population that had cases of illness each week [25]; an average weekly prevalence was calculated. Prevalence was calculated by dividing the number of participants reporting an illness by the number of questionnaire respondents for that week [21]. Prevalence of substantial impact illnesses was also calculated and was defined as illnesses which lead to reductions in training volume and performance,

either moderate or severe, as well as complete inability to participate in training or competition [21].

Illness incidence was defined as the rate at which new cases of illness occurred in the study population during a specified period [25]. Illness incidence per 1000-player days and time-loss illness incidence per 1000-player days were calculated. Prevalence and incidence measures were presented as weekly averages with 95% CI.

Severity scores, including weekly, average weekly and cumulative, were calculated for each illness and body system affected using methods previously outlined [23]. The cumulative severity scores for all illnesses were summed, and the proportion of the total number made up by body systems affected was determined to estimate the relative burden of different types of illnesses. Answers to the open-ended question regarding consequences of illness were checked for common themes using thematic analysis techniques; similar responses were grouped and quantified.

Results

Participants had 100% compliance for questionnaire completion. During the 25-week study, a total of 2975 player days were assessed (training; *n = 1394*, rest; *n = 1292* and competition; *n = 289*). Participants competed in 17 competitive fixtures, as part of the Super League under 19s Academy Championship.

A total of 24 new illnesses were reported over the 25-week study period. Just under two thirds (65%) of players experienced at least one illness during the study. This resulted in a mean incidence of 1.4 illnesses per player. The most commonly affected body system was respiratory (*n = 15; 62.5%*), followed by digestive (*n = 5; 20.8%*) and skin (*n = 4; 16.7%*). The most common symptoms reported were blocked nose / running nose / sneezing (*n = 9*) and sore throat (*n = 8*).

The total incidence of illness was 14.3 per 1000-player days (95% CI; *9.6 to 21.3*). The average weekly illness prevalence was 10.3% (95% CI; *9.3 to 11.4%*). In 63% of illnesses (*n = 15*), athletes reported no time-loss days or training volume reduction but continued to train despite suffering from an illness.

Eight time-loss illnesses were reported with a total of 19 days lost to illness (mean and SD; 2.4 ± 1.8 days), with six days being the greatest amount of time lost due to a respiratory system illness. One in three illnesses resulted in time-loss, with time-loss illness incidence accounting for 1.4 per 1000-player days (95% CI; *0.7 to 2.8*). The amount of time lost was greater from respiratory system illness (*n = 12 days; 63%*) compared to digestive system (*n = 7 days; 37%*). No time was lost to skin complaints.

The relative burden of body systems affected was calculated using the cumulative severity score. The respiratory system was the highest burden (49%), followed by skin (27%) and digestive system (24%). The most commonly reported consequence of illness was loss of body mass (*n = 4*). The mean body mass loss from all athletes during a period of illness was 2.2 ± 0.6 kg. Sleep disruption was also reported (*n = 3*). One player was unable to compete in match-play due to illness despite being selected for the team.

<Insert Figure 2 near here>

Discussion

This study aimed to assess the incidence, prevalence and consequences of illnesses in one professional academy rugby league club during an in-season period. To our knowledge this is the first study in rugby league to establish incidence and prevalence, as well as the additional consequences of illness, including loss of body mass and disrupted sleep, which may hinder athletic development in Academy players. This information can be used to better support

athletes during periods of illness, including additional nutrition support to prevent excessive body mass loss and education of sleep hygiene protocols. In agreement with previous research at the senior level in rugby league [2, 12], as well as across illness surveillance within elite international rugby [1], the findings show the most common body system affected by illness was the respiratory system.

In the current study, the average illness incidence was 1.4 illnesses per player during the investigation period. These findings are similar to previous research undertaken at the senior Australian level where illness accounted for approximately 1.4 illnesses per player (45 illnesses in 32 players), albeit over a 29-week pre-season and competition period [12]. When split by playing teams however, illness incidence was greater in National Rugby League (NRL) players (1.94 illnesses per player) compared to New South Wales cup players (0.83 illnesses per player) [12]. As previously suggested, rugby league players may experience greater illness risk as playing level increases due to increased stressors [12], however further research is required to examine this. An additional limitation of the current study is the lack of non-athlete age-matched cohorts. Inclusion of a control sample would have provided greater understanding of the impact of illness. Previous studies have assessed elite adolescent athletes' illness prevalence compared to sub-elite age matched cohorts. One study reported slightly greater weekly prevalence of illness (14%) in sub-elite athletes compared to elite athletes (12%) [24] and previous research has suggested that sport participation could be protective and reduce the risk of illness in athletes [1].

Illness incidence findings in the current study (14.3 per 1000-player days) are lower than previous research undertaken in rugby union, during an international competition (20.7 per 1000-player days) [9]. This could be due to the competition period that was assessed, which may have resulted in higher match frequency, increased exposure to other players and possibly greater exposure to pathogens, due to frequent air travel, which has been shown to increase risk of illness by 2 – 3-fold [10]. On the contrary, the current study showed greater time-

loss illness incidence (1.4 per 1000-player days [95% CI; *0.7 to 2.8*]) compared to senior professional rugby union players (0.8 per 1000-player days) over two full seasons [26]. Despite this difference, it should be acknowledged that time lost from illness may not pose as great a burden to Academy rugby league players as time lost from injury. Previous research within this cohort identified that one injury results in greater time-loss (22 ± 19 days on average) compared to illness (2.4 ± 1.8 days). Academy rugby league players anecdotally receive less medical support than professional full-time players. Appropriate medical provisions should be provided for Academy rugby league players to provide support during periods of illness to limit the impact of these consequences.

Throughout this study, many athletes continued to train despite suffering from an illness and thereby experienced no time-loss or training volume restriction (*n = 15*). Skin complaints were one of the most common complaints that athletes continued to train with and accounted for 16.7% of all illnesses. The percentage of all skin complaints in this study is in line with that of Cross [26] who reported 20% proportion of illness from skin complaints in a professional rugby union team. However, research undertaken over a 20-week in-season period in female youth soccer players found athletes did not report any skin complaints [27]. Due to the contact nature of rugby, it is hypothesised that the confined environment and frequent player-to-player contact may increase the risk and rate of skin complaints in this population [9]. Furthermore, exposure to soil and dirt, as well as inconsistent covering of skin complaints may have increased transmission between players. Exclusion from match-play is suggested for those who do not cover skin complaints appropriately [4], i.e. using medical tape.

A further novel aspect of this study was the assessment of consequences of illness in this cohort. Loss of body mass was the most commonly reported consequence during an illness, with a mean loss of 2.2 ± 0.6 kg during an illness episode. Long-term improvements and changes in body mass and strength are required by Academy rugby league players between the ages of 16 to 20 years old, to help players progress through the development pathway [19].

Collective loss of body mass at this time, caused by frequent illness episodes, could limit a player in their long-term development. Additionally, sleep disturbances were also reported as a consequence of an illness episode. It has been hypothesised that sleep disturbance could result in decline of both short-term recall and working memory performance, which may impact rugby league players who require tactical awareness for set match-plays [28].

While this study provides practical data, it is important to consider that this study did not assess the multifactoral stressors that may influence illness, such as, immune markers, nutritional intake and training load, which may have identified periods of increased risk of illness. Furthermore, another limitation of this study is the lack of physical examination and diagnosis at the time of the illness. As athletes were only required to self-report symptoms, the incidence of illnesses may have been over estimated and recall bias may have resulted in inaccurate reporting. Symptoms of URI can mimic that of inflammation or allergy [1], however contrary evidence suggests that athletes and general population (controls) are able to accurately diagnose symptoms of upper respiratory tract infection (URTI) in 94% of cases when diagnosed by a physician [29, 30]. An additional limitation of the study is the small sample size which may limit generalisation of results to the wider rugby league population and may be inherent to this rugby league training environment.

Conclusion

Academy rugby league players are most commonly affected by respiratory illness with a total of nineteen training and competition days lost to illness. A total of 24 new illnesses were reported over the 25-week study period, with an average illness incidence of 1.4 per player. Illness incidence accounted for 14.3 illnesses per 1000-player days, with time-loss illness accounting for 1.4 illnesses per 1000-player days. In conclusion, illness may present a challenge to Academy rugby league players due to the associated consequences which may negatively impact a rugby league player's development, however it is acknowledged that injury remains the greatest contributor to time lost from training and competition. Appropriate medical

provisions should be provided for Academy rugby league players to provide support during periods of illness to limit the impact of these consequences.

Practical Implications

This study provides important considerations for those working within youth sport requiring physical development through player pathways.

- Athletes and practitioners should be aware of the consequences of illness episodes, such as loss in body mass and sleep disturbances, which may impact long-term development.
- Practitioners should ensure athletes are appropriately supported during illness episodes to reduce time-loss from training.
- Skin complaints should be suitably covered as athletes regularly continue to train and play whilst suffering from these.

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Figure Legends

Figure 1 – The four key questions from the adapted weekly online Oslo Sports Trauma Research Centre (OSTRC) questionnaire on health problems [21]

Figure 2 – Weekly prevalence of all illnesses across the 25-week study (filled bars). Weekly prevalence of substantial illnesses across the 25-week study (clear bars).